OTS: 60-11,783

JPRS: 2865

15 June 1960

SOVIET INDUSTRIAL DEVELOPMENT

NO. 11

SELECTED TRANSLATIONS

Distributed by:

OFFICE OF TECHNICAL SERVICES
U. S. DEPARTMENT OF COMMERCE
WASHINGTON 25, D. C.

Price: $1.00

U. S. JOINT PUBLICATIONS RESEARCH SERVICE
205 EAST 42nd STREET, SUITE 300
NEW YORK 17, N. Y.

OTS: 60-11,711

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Introduction

This is a serial publication containing selected translations on industrial development in the Soviet Union. This report consists of a translation of a brochure, entitled Chernaya Metallurgiya v Semiletii (Ferrous Metallurgy in the Seven-Year Plan).

FERROUS METALLURGY IN THE SEVEN-YEAR PLAN

/This is a translation of a brochure written by P. I. Polukhin and B. G. Grinberg, Moscow, 1960, pages 3-30./

Introduction

The 21st CPSU Congress marks the entry of our country into a new period of its development -- the period of the advanced building of the Communist society.

The decisions adopted by the Congress with regard to the report of Comrade N. S. Khrushchev "On the Target Figures of the Development of the National Economy of the USSR in 1959-1965" arm the Party and the Soviet nation with a magnificent program for the building of Communism.

The task of creating the material-technical base of Communism, the task of overtaking and outdistancing within a historically brief period the highest-developed capitalist countries with respect to per capita output confronts the Soviet nation in all its magnitude. The Seven-Year Plan provides for increasing the gross industrial product by approximately 80 percent. In this connection, the production of means of production will increase by 85 percent, and the production of means of consumption, by 62-65 percent. In 1960 the gross industrial product will increase by 8.1 percent compared with 1959.

The most important branch of heavy industry is the metallurgical industry. Ferrous and nonferrous metals are not only needed in machine building but also are required by other branches of industry and, in addition, transport, construction, communications, etc. Metal is the keystone of our industry. Lenin called metal one of the foundations of modern civilization. A country's level of industrial development, its economic and defensive might, is judged by its output of pig iron and steel.

The 1960 plan provides for major measures to advance ferrous metallurgy. The output of pig iron is scheduled to rise nine percent, steel -- eight percent, rolled stock -- seven percent, and pipe -- 12 percent.

The Soviet metallurgists face the task of storming new, lofty ramparts in order to raise the smelting of pig iron in 1965 to 65-70 million tons, steel -- to 86-91 million tons, the output of rolled stock -- to 65-70 million tons, and extraction of marketable iron ore -- to 150-160 million tons.

The construction of ferrous-metallurgy enterprises will be subsidized with approximately 100 billion rubles, which is 2.4 times as much as the capital investments in ferrous metallurgy made in the years 1952-1958. In this connection, the capital investments in the development of the iron ore industry alone will increase 2.8 times. Two-thirds of all assigned funds are earmarked for augmenting the output capacities of the existing enterprises, for their expansion, renovation, and modernization of equipment.

Over 40 percent of the total volume of capital investments is assigned for developing the eastern regions -- including the Urals, Siberia, the Far East, Kazakhstan, and Central Asia -- in 1959-1965.

The concrete paths of development of technological progress in ferrous metallurgy are clearly outlined in the decisions of the June (1959) Plenum of the CC CPSU. That plenum emphasized that the primary task consists in the over-all mechanization and automation of all technological processes, especially the auxiliary ones which occupy about one-half of the entire manpower of ferrous metallurgy.

Below we shall familiarize the reader with the progressive technology and new equipment being introduced into various branches of ferrous metallurgy.

Iron Ore Industry

The enormous increase in the smelting of ferrous metals envisaged by the Seven-Year Plan requires a commensurate expansion of the raw material base of metallurgy.

The ore mining industry should ensure blast furnaces with an unbroken supply of iron ore, and hence the development of that industry should outdistance the development of metallurgy. Therefore, the Seven-Year Plan provides for constructing a large number of new large mining enterprises, expanding the existing ones, and introducing up-to-date technology combined with over-all mechanization and automation of the basic and auxiliary production processes in the ore-mining industry.

Iron ore extraction in 1960 will exceed 105 million tons. This will greatly promote the elimination of the lag of the iron ore base behind the needs of metallurgy.

In 1965 our iron ore industry should ensure an extraction of 150-160 million tons of marketable ore and capture the leading place among the world's iron ore industries.

In our country much has been accomplished in prospecting for mineral resources, and this had led to discoveries of new ore reserves. The Soviet Union now has the largest proven iron ore reserves in the world. Two-fifths of the world's iron ore reserves are concentrated on the territory of the USSR; the explored reserves of these ores there exceed 35 billion tons. According to data available on 1 January 1958, the total geological reserves exceed 85 billion tons. This is 3.3 times as much as in the United States, England, France, and West Germany, taken together.

Ferrous metallurgy develops in both the old and the new regions of the country. The discovery of new iron ore basins has altered the geographical distribution of iron ore resources. The target figures for the development of the national economy of the USSR in 1959-1965 point to the necessity of developing metallurgy not only in the traditional but also in the new regions. The establishment of new centers of the metallurgical industry will curtail long-distance hauls of raw material, fuel, iron scrap, and finished products.

At present the Third Metallurgical Base is being established in the east of our country on the basis of the recently discovered iron ore deposits of Siberia and Kazakhstan. Also, a further expansion of iron ore extraction is scheduled to occur at the Second Coal and Metallurgical Base, established in the Urals and Siberia in the years of the Prewar "pyatiletkas."

The development of ferrous metallurgy in the central regions and in the south of our country (the First Metallurgical Base) will continue on the basis of a broad utilization of the extensive reserves of iron ores of the Kursk Magnetic Anomaly and the Krivoy Rog Iron Ore Range.

On the Kerch Peninsula ore outcrops to the surface and is mined by the open-strip method. That deposit, with its three billion tons of ore reserves, coupled with the coking-coal reserves of the Donets Basin, serves as the base of ferrous metallurgy on the shore of the Sea of Azov.

As of 1957, iron ore extraction was begun in Kazakhstan, 50 km from Kustanay. There, on the basis of the Sokolovka-Sarbay Iron Ore Deposit, whose reserves of low-phosphorus ores exceed 10 billion tons, an ore combine with an annual output capacity of over 10 million tons is being established. The same region is also the site of the enormous deposits of the Ayat high-phosphorus /iron/ ores.

The Seven-Year Plan provides for the construction and development of new large deposits: Nizhne-Angara and Angara-Pit in East Siberia, Kachkamarskiy in the Urals,

Atasu in Kazakhstan, and many others. The construction of ore-mining enterprises on the deposits of the Kursk Magnetic Anomaly, Krivoy Rog Iron Range, the Urals, Kazakhstan, and Siberia, will make it possible to create a substantial raw material base of ferrous metallurgy for many scores of years in advance.

The principal trends of technological progress in the ore-mining industry are widespread employment of open-strip mining operations, increase in the beneficiation of ores, introduction of new high-productivity mining system, further mechanization of mining, and perfection of the existing machinery and mechanisms so as to increase their productivity.

A number of processes will be improved by introducing over-all mechanization and automation, and closed-circuit television installations will be more widely introduced.

One of the principal trends in the technological advancement of the iron ore industry is the broader introduction of open-strip mining. The open-strip method of extracting minerals make it possible to mechanize more fully all technological processes and to alleviate the labor of miners. Such a mining method is much more economical than the underground method. The share of open-strip mining in the total volume of mining in the USSR amounts to 55 percent. The Seven-Year Plan provides for boosting this share to 69 percent.

Of great importance to a successful fulfillment of the Seven-Year Plan in the iron ore industry is the use of new, progressive methods of drilling, transporting and blasting. The transition from the hitherto most popular method of cable-tool drilling to the method of rotary and thermal drilling will increase productivity 10-12 times.

The sharpening of drilling bits in the USSR at present is conducted on DS-1 bit-sharpening machines whose productivity does not exceed 12-15 bits per shift. It is necessary to organize the manufacture of high-productivity bit-sharpening machines ensuring the sharpening of 75 bits per shift, with automatic heating and hardening, and with the milling of bid edges as well.

Upon the mechanization of the charging of boreholes, the charging rate climbs to 10-15 tons of explosives per hour. Special motorized bins will be used for this purpose.

The use of new explosives will make it possible to reduce the diameter of boreholes and blast holes, curtail the consumption of drilling steel, increase the efficiency of boreholes and blast holes during blasting operations, and yield considerable savings of funds.

The loading of bulk rock in the strip pits will increase greatly through the widespread use of rotor-type, multiple-bucket and walking excavators with a 14-25 m^3 bucket, a 100-meter boom, and a 16-meter discharging height. To increase the speed of loading operations, crushers with belt conveyers will be installed in the larger strip pits. To raise labor productivity during the transporting of bulk rock, electric and diesel locomotives with tractive strength of 100-150 tons, side-tilting-dumpcars with capacities of 60, 90 and 100 tons, and self-propelled dump-cars with a capacity of 120 tons will be installed.

The mechanization of track and auxiliary operations will be promoted by manufacturing railroad cranes with lifting capacities of 40-50 tons and a 30-meter boom, while the installation, dismantling and repairs of excavators in strip pits will be promoted by the manufacture of self-propelled railroad cranes with a 100-ton lifting capacity and an eight- or nine-meter boom.

Motorized transport has not as yet been adequately used in mining operations. Plans exist for mastering in the immediate future the production of heavy-duty tractors (bulldozers) of up to 250 HP for dump and road operations and for trimming the terraces in strip pits. In addition, it will be necessary to use tractors, dump trucks, and trailer trolleys with load capacities of 10, 24, 40, and 60 tons, for haulage work.

In our country a considerable part of iron ore is mined by the underground method. Signal improvements have taken place in the techniques of the underground extraction of ore: thus, e. g., the rate of sinking mine shafts has increased; thanks to the introduction of hammer drilling the productivity of ore breaking has been doubled; the processes of underground and surface haulage have been completely mechanized; and so forth.

In the next few years the labor productivity and technological level of ore extraction will increase even further.

For this purpose, the most productive and economical mining systems will be introduced, the organization of labor will be improved, and the mechanization of all extracting and transporting processes will be increased. Cages, skip hoists, mine cars, props, and other equipment will be manufactured of aluminum alloys.

To increase the shaft-sinking rate to 100 meters/month and the level-tunneling rate to 150 meters/month, it is necessary to organize the serial manufacture of drilling installations for sinking shafts, to raise the capacity of the buckets of tracked loading machines to one m^3, and to

introduce mine props of precast reinforced concrete members, bolted supports, and a number of other measures.

One of the principal measures is the introduction of methods of drilling mine shafts not requiring the presence of a man on the floor of the shaft.

The improvements in the underground transport operations will proceed along the path of the employment of large mine cars (holding as much as 10-25 m^3) and electric locomotives with a tractive force of 30 tons.

All dispatcher points and main assemblies will be provided with short-wave transmitters and closed-circuit television.

Numerous other examples of the introduction of up-to-date technology into the iron ore industry could be cited, but the above-described measures are indicative of the enormous scope of the work to be accomplished in the seven-year period.

Considering that the low-grade ore pits will also be exploited, ore beneficiation acquires a special importance. In the next few years the plans call for constructing mining and dressing combines on a number of iron ore ranges for the purpose of averaging and concentrating raw ore. Five large combines are scheduled to be built in the Zaporozh'ye Region, and one, in the Novo-Kremenchug Deposit; also, the Kamysh-Burgunskiy Combine in the Ukraine is being expanded, and so forth.

The concentration of ore, i. e., increasing its iron content through a reduction in its content of side admixtures, is extraordinarily important. Comrade L. I. Brezhnev declared at the 21st CPSU Congress that: "If our metallurgical plants are completely assured of dressed ore, and if the iron content of that ore is increased by 1.5 to 2.0 percent, then it would be possible to obtain additionally more than two million tons of pig iron from the existing blast furnaces."

New Developments in the Technology of Pig Iron Production

One of the principal trends in the development of blast-furnace work is the expansion of the useful volume of the average blast furnace and the improvements in its design. In the largest of the modern blast furnaces it is possible to smelt over 2,000 tons of pig iron daily. While in 1928 the average useful volume of blast furnaces amounted to 290 m^3, at present one furnace with a volume of 1,719 m^3 is already in operation.

In 1960 several large blast furnaces will be activated, including one with a useful volume of 2,000 m^3. The use of large blast furnaces serves not only to provide the country with more metal but also to promote a substantial increase in furnace productivity -- metal smelted-out per worker.

The largest blast furnace in the United States has a useful volume of 1,810 m^3 and has operated since 1955. In England a furnace with a volume of 1,745 m^3 has operated since 1956, and another, with a volume of about 1,800 m^3, is under construction.

In the next few years the increase in the capacity of blast-furnace production in the USSR will be attained by activating large-volume furnaces and, as well, by expanding the volume of the existing furnaces through their reconstruction, which appears to be the most economical method of increasing pig iron output.

The materialization of the intended measures will increase the average blast-furnace volume from 844 m^3 at present to 1,150 m^3 in 1965, i. e., double it /sic/, which make it possible to smelt out approximately 550,000 tons of pig iron per blast furnace annually. The effect of the use of large-volume blast furnaces on the rise in labor productivity is illustrated by the following figures:

Blast-furnace volume (in m^3)	Pig iron smelted out per worker (in tons a year)
200	505
1,870	7,000
2,000	over 10,000

The technical indexes of performance of our blast-furnaces surpass the analogous indexes in the Capitalist countries. The largest blast furnace in the United States, with a volume of 1,810 m^3, yields 1,800-1,950 tons daily, whereas in the USSR such a productivity is displayed by furnaces with a volume of 1,300-1,386 m^3. In certain Soviet plants, blast furnaces with a volume of 1,370 m^3 smelt out 2,200-2,500 tons daily.

In pig iron output one of the principal technical-economic indexes is the ratio of blast furnace useful volume to daily pig iron production. At present that ratio in the USSR as a whole averages 0.768. At the Magnitogorsk, Cherepovets and Kuznetsk plants that ratio amounts to 0.610. In the metallurgical plants of the United States the ratio of blast furnace useful volume to daily pig iron production

averages about 1.0, i. e., the United States furnaces operate at smaller intensity.

The increase in blast-furnace productivity and reduction in the unit rate of coke consumption are promoted by the use of fluxed sinter, operation at higher pressure of the gas in furnace top, employment of blast with a fixed moisture content, natural gas, oxygen-enriched blast, etc.

The operating practice of metallurgical plants has shown that the sintering of ore fines (powdery ores, fine concentrates obtained during ore beneficiation) increases blast-furnace productivity by 10-25 percent and reduces coke consumption by 7-20 percent.

At the Magnitogorsk Metallurgical Combine the amount of sinter in ore charge has been increased to nearly 100 percent. It was precisely with such charge that the Magnitogorsk blast-furnace men have achieved a considerable intensification of the blast-furnace process.

According to the data of Soviet researches, the productivity of a blast furnace charged with a 100-percent sinter burden increases by 26 percent and its coke consumption decreases by 17-21 percent.

The USSR is the world's leading sinter producer. At present the share of sinter in blast-furnace charge averages 70 percent in the USSR, 24 percent in the United States (1956), 29 percent in England (1955), and 98 percent in Sweden (1957).

Side by side with the use of conventional sinter, the use of fluxed sinter is growing also. In 1958 over 90 percent of all sinter produced in the USSR was in the fluxed form. In 1960 the output of fluxed sinter should rise to 73 million tons.

The use of fluxed sinter makes it possible to reduce the amount of limestone in the charge, if not completely eliminate it. In this connection, the heat-consuming process of the decomposition of limestone is shifted to the "aglolenta" /Dwight-Lloyd sintering machine/, which facilitates blast-furnace operating conditions and promotes a reduction in the unit consumption of coke.

Upon the use of fluxed sinter with a basicity of 1.26 at the Magnitogorsk Combine, the productivity of its blast furnaces increased by 12.2 percent and coke consumption decreased by 6.4 percent. At present the basicity of sinter has been raised to 1.4 The use of fluxed sinter at the Krivoy Rog Plant has served to reduce the ratio of blast furnace useful volume to daily production from 0.82 to 0.77, i. e., to increase the utilization of furnace by five percent. The replacement of ore by sinter increases blast-furnace productivity and reduces coke consumption by

two percent for every additional 10 percent of sinter introduced into the charge.

The Seven-Year Plan provides for assuring all blast furnaces with fluxed sinter having a 20-percent higher basicity compared with its present average basicity. The use of fluxed sinter improves the converting ability of gases in the blast furnace, reduces the consumption of materials per pig iron unit, and by the same token improves the ratio of blast furnace useful volume to daily production.

In pig iron production a major influence is exerted by the establishment of stable operating conditions of furnace: improvement in the preparation of raw material, concentration of ores, assuring the constancy of the chemical composition of ores, screening of fines, and improvement in the quality of coke.

A major nonutilized potential for increasing ore extraction lies latent in the utilization of ores with a low iron content, whose reserves are tremendous. But this can be economical only if they are concentrated. Major achievements in concentration techniques serve to cut the concentration costs to an extent permitting the related expenditures to be completely compensated by the conveniences ensuing from the smelting of concentrated ores in blast furnaces.

Of great importance is the stability of the composition of iron ores. At the Magnitogorsk Combine, where great attention is paid to ore averaging, variations in the iron content of ore do not exceed ±1 percent. This is reached by planning the extraction of ore from various stopes, storing ore, and by other measures.

The charging of an ore with a continually varying composition into blast furnaces results in disturbances in the rhythmic performance of these furnaces, reduces their productivity and increases their fuel consumption. This also involves the danger of a decrease in furnace temperature and the yield of a pig iron that is substandard in its content of silicon and sulfur.

The most important measures for increasing blast-furnace productivity include operation at a higher pressure of the gas under furnace throat, raised blowing temperature, use of a blast with a fixed moisture content, employment of natural gas, and oxygen-enriched blowing.

The increase in the pressure of gases under the furnace throat favorably affects furnace performance by promoting a more uniform distribution of gases and, as a result, an improved utilization of their thermal and chemical energy. The positive effect of a higher pressure of gases consists in raising productivity, reducing the expul-

sion of furnace-throat dust, and cutting down coke consumption.

The increase in gas pressure inside a blast furnace is achieved by installing a special pinching valve in the gas flue outlet of the furnace.

In the USSR about 80 percent of all pig iron is produced at high gas pressure. At present in the USSR the pressure under furnace throat reached 0.8-0.9 atm, and in certain plants even 1.5 atm. To further the modernization of blast furnaces it is necessary to convert all blast furnaces to operation on a pressure of not below 1.5 atm, which will increase their productivity by approximately three percent. In the United States only 28 blast furnaces operate at a 0.35-0.85 atm pressure, and in England, two.

The widespread employment of highly heated (to 950°C and higher) blast with a constant moisture content (about 25 grams/m^3), first materialized in the USSR in 1939, ensures the stability of blast-furnace performance, increases productivity by an average seven percent, and reduces the unit consumption of coke by two percent. The constancy of moisture content is ensured by feeding steam to the furnace. To compensate the losses of heat on the dissociation of steam it is necessary to raise considerably the heating temperature of blast -- by approximately 9°C for every gram of steam.

At present 90 percent of the Soviet blast furnaces operate on a blast with a fixed moisture content. In the United States only 25 percent of pig iron is smelted out on this basis. To assure a fixed humidity of the air regardless of seasonal fluctuations, blast furnaces should be equipped with devices for automatic regulation of steam feed and desiccation of blast.

A substantial increase in metal output can be achieved through the automation of production processes; 96 percent of all pig iron in our country is smelted out in blast furnaces with automatic regulation of blast temperature. The automatic regulation of the temperature of the hot air of air heaters is conducive to a more smooth performance of blast furnace, reduction in the consumption of gas on heating the blast, and increase in the resistance of the masonry of air heaters. The saving of fuel in air heaters then reaches five percent, and the consumption of coke declines by two percent. The productivity of blast furnaces is increased.

In blast furnace production a great deal of work has been done on the automation of weighing and charging hoppers and of the charging of blast furnaces. This work

is to be further pursued with the goal of the complete exclusion of human participation in the loading, weighing and haulage of charge. This will include research in the automation of regulation, distribution of blast among the tuyeres, control of temperature in tuyere centers, and control of the distribution of the gas flow throughout the blast furnace cross section.

The conduct of the above measures will make it possible to solve the problem of the automatic regulation of the technological mode of performance of blast furnaces and the guidance of their operations.

Experiments in the use of natural gas in blast furnaces have been in progress in the USSR as of 1957. They have demonstrated that the use of natural gas will reduce coke consumption, increase labor productivity one and one-half times, and cut pig iron costs.

Over 50 blast furnaces are scheduled to be converted to a new technological regime employing natural gas.

The enrichment of the blast with oxygen should exert a major influence on the productivity of blast furnaces. By the end of the Seven-Year Plan oxygen will be used in smelting out 35 to 40 percent of all pig iron. The concurrent employment of natural gas and oxygen blast will appreciably reduce coke consumption and raise blast-furnace productivity.

As a result of the introduction of the over-all mechanization of the technological processes of blast furnace production, automatic regulation of the feed of charge materials, natural gas, oxygen, automatic gas sampling, and other measures, the consumption of coke will decrease by 10-12 percent by the end of the seven-year period and the ratio of blast furnace useful volume to daily production will improve and amount to 0.6 or even less. The mean annual increment in the smelting out of pig iron during that period will rise to 3.6-4.4 million tons against a mean annual increment of 2.5 million tons during the 1952-1958 period.

In 1959-1965 the newly activated pig iron output capacities will total 24-30 million tons against 16.3 million tons in the 1952-1958 period. Pig iron output in 1965 will total 65-70 million tons, or 64-77 percent more than in 1958.

Calculations have shown that in 1965 10 million tons of the total pig iron output will be obtained as a result of the introduction of new technological processes, intensification of the smelting process, and over-all mechanization and automation of all production processes; a total of 20 million tons will be obtained as a result of the con-

struction of new blast furnaces in the existing and newly planned metallurgical enterprises.

"The construction and reconstruction of enterprises of ferrous and nonferrous metallurgy are scheduled to be backed with more funds," declared Comrade N. S. Khrushchev in his report at the 21st CPSU Congress, "than the total invested in the past 30 years. In this connection 67 percent of capital investments in ferrous metallurgy and about 60 percent of the investments in nonferrous metallurgy will be earmarked for the expansion and modernization of the existing enterprises, which should provide over three-fourths of the planned increment in [the output of] pig iron, steel, and rolled stock."

Such an utilization of funds is most pertinent, as is illustrated by the following example: the capital investments per ton of pig iron in the construction of the Karaganda Metallurgical Plant amount to 2.347 rubles, whereas in the expansion of the Magnitogorsk Combine they total only 1,947 rubles.

Progress in the Field of Steel Production

Year after year the output of ingot steel is rising in our country. In 1960 nearly 65 million tons of steel will be smelted out. In 1965 this figure will climb to 86-91 million tons. Thus, the Soviet Union will move nearly abreast of the contemporary level of steel production in the United States.

At present the Soviet Union is Europe's leading, and the world's second-ranking, steel producer, smelting out as much steel annually as is smelted by England, West Germany and Italy taken together.

Steel occupies the topmost rank among the metals used by man. The more steel in a country the richer and stronger it is.

In the USSR about 90 percent of all steel is smelted out in open-hearth furnaces. In recent years our steel smelters have accomplished considerable feats. The average yield of steel from one square meter of furnace hearth has climbed from 5.36 tons in 1950 to 7.55 tons, and in individual plants, as high as 9-10 tons, in 1958. Such high operating indexes of open-hearth furnaces have been attained primarily because of the introduction of new progressive technology, growth in the technical competence of cadres, and broad employment of high-speed smelting.

The principal technological trends in the development of steel production in 1959-1965 in open-hearth furnaces

are as follows: increase in the capacity and perfection in the design of these furnaces; standardization of charge; employment of oxygen and compressed air to intensify the torch and the direct oxidation of impurities in the bath; employment of natural gas; and utilization of magnesite-chromite and magnesite-chrome-refractories in the masonry of furnace arches. In addition, evaporatory cooling of open-hearth furnaces and the installation of heat-recovery boilers in their rear will be widely practiced. High-speed steel melting, continuous and semicontinuous steel teeming, and the over-all mechanization and automation of the technological process in all of its links will be widely introduced. The vacuum process will be widely used in the smelting and teeming of steel.

One of the principal tasks of the seven-year period is the construction of large open-hearth furnaces; this, in turn, will serve to trim capital expenditures by over 30 percent and to reduce drastically the attending personnel and cut the production costs of steel.

The increase in the capacity of open-hearth furnaces ensures not only the production of a greater amount of metal but also a substantial rise in labor productivity per worker and a decline in the production costs per ton of steel (see Table).

Indexes (in percent)	Capacity of Open-Hearth Furnaces in tons				
	185	220	370	440	500
Production Cost of Carbon Steel	100	99	97	96.5	96
Capital Expenditures per ton of Steel in relation to Annual Productivity	100	98.3	89.3	87.2	85
Labor Productivity per Worker	100	117.9	129.4	131.8	135

In the USSR at present the maximum capacity of an open-hearth furnace amounts to 500 tons. In 1960 the first 600-ton automated open-hearth furances will be set in operation.

The designs of the new, large open-hearth furnace provide for teeming steel into two ladles. The percentage of

large open-hearth furnaces in the metallurgical plants of the USSR is greater than in the United States, England, and other countries. Thus, the number of furnaces with capacities of 200 and more tons accounts for 24 percent of the total in the USSR, 13 percent in the United States, and 10 percent in England. The mean annual productivity per 500-ton open-hearth furnace amounts to 243,000 tons in the USSR and 233,000 tons in the United States.

The Seven-Year Plan envisages the construction, for the most part, of open-hearth furnaces with capacities of 500-540 tons. The new steel smelting capacities to be introduced during that period will be 28-36 million tons greater than in the 1952-1958 period. Many of the new open-hearth furnaces will be built in the existing enterprises, and the steel output of the existing assemblies will increase by more than eight million tons.

Of enormous importance to the development of high-speed steel smelting is the use of highly resistant refractories in open-hearth furnaces.

At present about 90 percent of all steel is smelted in open-hearth furnaces whose arches are lined with magnesite-chromite or magnesite-chrome-refractories. The use of these refractories has approximately doubled or tripled the resistance of furnace arches, and it has made it possible to raise arch temperature from 1,680°C to 1,750°C. As a result, the process of smelting became greatly intensified, furnace stoppages were reduced by three to four percent, and furnace productivity was raised 10 percent.

The advantages of the use of thermo-resistant basic arches in open-hearth furnaces often cannot be entirely utilized because of insufficient resistance of the air-heating checkerwork, whose service life is much shorter than the service life of these arches. The fine iron-oxide dust carried by the smoke forms an easily fusible compound with the silica of the brick which corrodes the Dinas brick of the checkerwork, so that the latter may not be heated to more than 1,250°C. At intensive operation of the furnace, the smoke temperature rises to 1,700°C-1,800°C and the checkerwork overheats and disintegrates, which causes stoppage of the furnace for cold repair despite the satisfactory state of the magnesite-chrome arch.

To slow down the disintegration of the checkerwork, it was necessary to restrict the heating of the upper rows of the checkerwork artificially to a temperature of 1,250°C, which curtailed furnace productivity.

The steel smelters of the Zaporozh'ye Region arm in arm with the researchers of the Dnepropetrovsk Metallurgical Institute have solved this problem by lining the

upper rows of the checkerwork with slag-resistant brick (magnesite-chrome, dunite-forsterite, dolomite). The temperature of the checkerwork of magnesite-chrome brick was raised to 1,500°C, and of forsterite brick, to 1,400°C. As a result, the resistance of the checkerwork was appreciably improved, the furnace heat was utilized more satisfactorily, the duration of smelting was reduced by nearly 20 percent, and the consumption of fuel per ton of steel was reduced by as much as 15 percent.

In the USSR 66 percent of open-hearth furnaces have basic arches, while in the United States this percentage is only 0.5; in England, 2.5; in France, 13.6; and in West Germany, 43.2 percent. Magnesite refractories have not become popular in foreign countries, because of the extremely limited resources of magnesitic raw material.

The intensification of smelting processes, use of high-calory types of fuel, and employment of oxygen blowing, result in a rise in furnace temperature, and hence they require the use of improved, highly resistant refractories.

The seven-year period will witness an expanded production of magnesite-chromite, magnesite-chrome, magnesite, Dinas-chromite, and forsterite refractories for existing and newly built open-hearth furnaces.

The use of oxygen in open-hearth work appears to be of great promise, because steel smelting processes are oxidatory and occur at high temperatures. The use of oxygen makes it possible to conduct smelting at a high temperature regime of the furnace during the periods of the charging, heating and smelting of the burden, and it serves to intensify the process during the final stages of smelting and carbon burning.

As a result of the use of oxygen in open-hearth work, furnace productivity increases 20 percent, fuel consumption decreases 15 percent, and the quality of steel improves, so that the reduction in the heating and smelting time of the charge is accompanied by a reduction in its gas saturation.

The Seven-Year Plan provides for a continuous increase in the oxygen-employing production of steel, until it reaches as much as 75 percent of the total production of steel in 1965, i. e., about 64 million tons of steel annually. Substantial benefits are yielded by the use of oxygen for the direct oxidation of furnace bath. The pre-blowing of the bath with oxygen accelerates the process of the burning-out of silicon and increases the productivity of the furnace. The delivery of compressed air to the head of an open-hearth furnace increases its productivity by another eight percent. To cut the production costs of oxygen, large-

capacity oxygen stations producing 5,000, 12,500, and 35,000 m^3 of oxygen an hour will be built.

The use of cold, high-calory gas with an admixture of mazut in open-hearth furnaces simplifies the design of these furnaces. The absence of checker chambers cuts the cost and time of furnace construction, improves furnace servicing, and makes it possible to automate the thermal regime completely.

A major effect is yielded by the use of evaporatory cooling in open-hearth furnaces. At such a system of the cooling of reinforcement, as distinguished from the purely aqueous cooling, the elimination of heat is carried out by means of a steam-water mixture and the consumption of water for cooling is reduced 10-20 times. At present 42 percent of all open-hearth furnaces have been converted to evaporatory cooling. By the end of the Seven-Year Plan all open-hearth furnaces should be converted to evaporatory cooling. In foreign countries, evaporatory cooling is only beginning to be introduced.

Considerable economic benefits are yielded by the installation of flue gas pumps with heat recovery steam boilers. The waste gases carry away 30-35 percent of all heat entering the furnace. The installation of heat recovery boilers makes it possible to utilize about 50 percent of the heat of the waste gases, reduce fuel consumption by 20 percent, and increase furnace efficiency.

The comprehensive utilization of heat recovery boilers and evaporatory cooling combined in a single common scheme should yield a substantial economic effect.

Of great importance to the simplification of the metallurgical cycle and increase in the output of acceptable steel is the introduction of installations for the continuous teeming of steel. When billets and ingots are produced by these installations, the need for blooming and slabbing mills is dispensed with. The expenditures on the construction of these installations are recouped within one or two years. The use of continuous-teeming installation yields a considerable economic effect, and increases the output of acceptable rolled stock by not less than eight percent.

The introduction of continuous teeming eliminates the casting of steel into chill molds, the heating and roasting of ingots, and the necessity of erecting enormous buildings and installing intricate technological and transport equipment and, lastly, it relieves the metallurgical shop from the difficulty caused by the presence of a large pool of chill molds. One of the principal advantages of the method of the continuous teeming of steel consists in

the feasibility of the automation of that process. A broader introduction of this method is scheduled for 1960. The world's largest installation for the continuous teeming of steel will then operate in the Donets Basin.

During the seven-year period continuous teeming of steel will be introduced into a number of plants where steel is poured into chill molds.

Our present industrial-type, teeming installations have a capacity of 50 tons an hour. The teeming is conducted from a ladle holding 50 tons. Installations for teeming steel from ladles holding 130 and 270 tons are under construction.

Small installations for teeming steel from ladles holding 15 tons are operated abroad. Steel-teeming installations with ladles holding 75 tons are being built in West Germany.

The standardization of charge is of extremely great importance to the increase in the productivity of open-hearth furnaces. The stability of the physical properties and chemical composition of the metallic part of charge, appropriate dimensions and volume-weight stability of steel scrap, proper organization of the blending of charge and its feeding to the furnace, and use of modern, large-capacity equipment for blending the lightweight metallic charge -- all this will sharply accelerate the charging of materials.

As is known, a major role in raising labor productivity and improving quality of output is played by automation. In open-hearth work, automation has been introduced into a number of processes. About 90 percent of all open-hearth steel is smelted out in furnaces with automatic regulation of thermal regime. The furnaces are equipped with regulators of the combustion process for the simultaneous burning of several types of fuel, regulators of the pressure of blast-furnace and coke gases in the working space of the furnace, valve-turning regulators, etc.

The further increase in the technological level of open-hearth work will make it possible to increase the yield of steel per m^2 of hearth area and to raise the annual production of steel per worker to 2,500 tons.

In the offing is a considerable expansion of the work on the over-all automation of the regulation of the thermal regime of open-hearth furnaces by means of computing-resolving devices. Experiments with such a scheme of automation as applied to a 370-ton open-hearth furnace at a metallurgical plant have demonstrated the possibility of obtaining 14.5-16 tons of steel per square meter of hearth area daily against the nine to 10 tons normally attained

at present.

The annual growth in the output of open-hearth steel is accompanied by a growth in the output of electric-furnace steel. At present eight percent of all steel in the USSR is smelted out in electric furnaces with an average capacity of 16.8 tons. The development of electric steel smelting work is fundamentally oriented toward a further increase in the capacity of arc and induction furnaces, perfection of the charging process, intensification of the melting process, increase in the power rating of furnace transformers, and introduction of the induction stirring of metal.

In addition to the small electric arc furnaces we possess furnaces with capacities of 40 and 80 tons. The seven-year period will witness the activation of furnaces with a capacity of 180 tons, with electromagnetic stirring of metal. The stirring of the steel bath, conducted by exposing it to the effect of a magnetic field, is one of the methods of intensifying arc-furnace smelting and improving the quality of the smelted-out steel.

The Seven-Year Plan provides for introducing electric stirring in furnaces with capacities of 20 tons and higher.

The widespread use of oxygen for intensifying the smelting is a characteristic trait of electric steel smelting work. Thus, e. g., in a number of plants, the smelting out of 1Kh18N9T grade stainless steel in oxygen-employing, 20- and 40-ton electric furnaces lasted 30-40 percent less time than usual. In this connection, as much as 70 percent of stainless steel wastes were used in the charge; consequently, the consumption of fresh nickel and ferrochrome was drastically reduced. The consumption of electrical energy decreased by 40 percent, and the percentage of rejects declined greatly.

To intensify electric steel smelting production and to improve the quality of steel, work on the mechanization of processes, with primary emphasis on the mechanization of charging, and on the automation of the electric regime of melting in arc furnaces, will be conducted in the existing shops. For the very first time anywhere, computers serving to maintain a set regime of introduction of thermal energy into a furnace with a high degree of accuracy will be applied for regulating arc power in the USSR. The introduction of computers for the guidance of the electric regime of smelting in an electric arc furnace yields a substantial effect.

The intensification of smelting processes has posed higher requirements to refractory materials, and this has led to a broader use of magnesite-chrome furnace arches.

The number of steel-smelting arc furnaces with magnesite-chromite arches has increased to 50 percent. Such arches last on the average for 95 smeltings, whereas the Dinas-brick arches last only 37 smeltings.

Uncalcined magnesite-chromite brick in steel boxes is used in the masonry of electric furnace walls.

The statements made previously about the use of new refractories in open-hearth production apply equally to electric steel smelting production.

Lately the vacuum smelting and teeming of steel has been increasingly applied. The vacuum smelting of steel usually occurs in closed induction furnaces, and in arc furnaces as well.

The development of atomic power, jet-propulsion engineering, and machine and instrument building poses increasingly higher requirements to the purity of metal. It is possible to obtain a metal with a minimal content of gases and nonmetallic inclusions by smelting it out in a vacuum induction furnace. However, only small amounts of the most important high-alloyed alloys are smelted out in such furnaces.

The considerable expansion of capacities for the vacuum smelting of a number of alloys and high-alloy steels, as scheduled in the Seven-Year Plan, will be accompanied by a broad introduction of the vacuum teeming of molten steel. The following methods of vacuum teeming of molten metal are in use: vacuuming in a ladle placed in a special chamber, pouring of metal from ladle to ladle under a vacuum, casting of ingots under a vacuum.

This yields a metal with a mineral content of gases and nonmetallic inclusions.

The quality of the vacuum-treated metal is superior to that of the metal obtained at conventional teeming -- it is more compact and displays higher plastic properties. The vacuum treatment of transformer steel makes it possible to reduce specific losses considerably, and thus to improve the quality of electrotechnical steel.

To increase the productivity of steel smelting arc furnaces, the charging of burden from the top is scheduled to be widely applied. This will also considerably shorten the charging time.

In converter operations the use of oxygen is of exceptional importance, because this assures a radical improvement in the quality of converter steel and makes it possible to smelt out a steel of a quality close to that of open-hearth steel.

The enrichment of the blast with oxygen makes it possible to shorten blowing time and by the same token to

increase converter productivity by approximately 20 percent. In this connection, the amount of the re-melted steel scrap increases from five to 30 percent. The nitrogen content of steel diminishes to 0.008-0.0012 percent and even 0.004-0.005 percent when a mixture of oxygen with water vapor or carbon dioxide is used, against 0.012-0.030 percent at operation with air. The construction of a converter shop costs 30-40 percent less than the construction of an open-hearth shop of the same capacity.

Oxygen is used in various forms in converter production: pure oxygen, oxygen-enriched blast, steam-oxygen blast, mixture of oxygen with carbon dioxide, and a number of other gas-air mixtures.

The output of converter steel will rise in the seven-year period. Converters with capacities of 90-100 tons each will be built. Labor productivity in a shop with large-capacity converter is 30-40 percent higher than in an open-hearth shop.

One advantage of the oxygen-employing converter process, when large-capacity converters are used, is, in comparison with open-hearth work, a greater productivity of the shop coupled with a smaller number of assemblies and lower capital expenditures. The productivity of a single 90-100 ton converter exceeds 1.75-2 times the productivity of a 500-ton open-hearth furnace.

Of great importance to the progress of ferrous metallurgy is the solving of the related problems. One such problem is the introduction into steel metallurgy of the treatment of phosphorous pig iron based on blowing oxygen through it in a rotor furnace and in a converter rotating about the major axis. Phosphorous slags can be used as agricultural fertilizers. The entire process last 18 minutes.

Progress in Metal Rolling

Over 80 percent of all steel smelted out in metallurgical plants is treated by rolling. Rolling mills provide a most variegated output: square, round, angle steel; beams, girders, rails, rabbets, and other shapes of section steel; plates, sheets, strips, tubes of various diameters, periodic /varying cross-section/ rolled stock, curved sheet sections; etc. The consumers of rolled stock are constituted by all branches of the national economy: machine building, industrial and civil construction, rail transport, communications, various branches of industry (mining, chemical, aviation, shipbuilding, power generation, etc.).

The Seven-Year Plan of Development of the National Economy of the USSR for 1959-1965 envisages the output of rolled stock in 1965 at 65-70 million tons, i. e., 53-63 percent more than in 1958.

To ensure the planned volume of rolled-stock output in 1959-1965 new capacities for the output of 23-29 million tons of rolled stock will be activated, 82 new high-productivity rolling and tube mills will be set in operation. Plans exist for establishing totally mechanized high-productivity blooming mills for rolling blooms from ingots weighing over 10 tons and slabs from ingots weighing 20 tons and having a width of as much as 1,600 mm. Slabbing mills will be built for rolling ingots weighing as much as 30 tons into slabs weighing up to 15 tons and measuring as much as 2,000 mm in width.

Assemblies for the continuous-flow pyro-cleaning of blooms and slabs will be installed in the rear of the blooming and slab bins mills.

To produce heavy rails (weighing 65-75 kg/running meter) and wide-ledge beams, old rail-structural mills will be modernized and new ones will be built. The modernized mills will be able to manufacture wide-ledge "beams with ledges" 250-300 mm wide, and the new mills will roll beams with ledges as much as 400 mm wide and as much as 1,000 mm high.

The manufacture of rails of alloy steel will be developed; the thermal treatment of rails will be widely introduced.

In accordance with the needs of the national economy, the Seven-Year Plan provides for a sizable increase in the output of sheets and tubes. The output of sheet steel should be nearly doubled. The output of thin sheets and cold-rolled sheets should be multiplied several times. While in 1940 the share of sheets in the total volume of the output of rolled stock amounted to 23 percent, and in 1950 -- 26.5 percent, this share is scheduled to rise to approximately 33 percent in 1965.

The increase in sheet output is required by the considerable demand of the national economy for sheets for the manufacture of welded tube for gas and petroleum trunk pipelines. After all, an enormous amount of pipe is needed to transmit natural gas over considerable distances.

To increase the output of sheet steel, modern continuous coiled-sheet rolling mills will be built. For instance, at present the machine builders of the Novo-Kramatorsk Plant are completing the construction of a new heavy-duty assembly -- the totally mechanized and automated "2,500" mill for the continuous hot rolling of sheets; its

annual output capacity will nearly equal the entire output of ferrous rolled stock in Tsarist Russia in 1913. It will be the largest rolling mill in Europe.

One of the principal trends in the development of the production of cold-rolled steel in the next few years is the installation of highly mechanized continuous four- and five-cage multiple-roll mills serving to ensure the production of a broad variety of cold-rolled steel products. Nearly all technological operations will be conducted on the basis of the coiling method of production, which makes it possible to attain a high degree of the automation and over-all mechanization of operations.

The activation of new cold-rolling shops in the next few years will make it possible to increase considerably the output of cold-rolled steel. The output of cold-rolled transformer steel, which, in comparison with hot-rolled steel of this type, has lower specific losses and higher magnetic induction, will be increased more than tenfold. The high quality of the surface of cold-rolled transformer steel makes it possible to increase considerably the fill factor and efficiency of transformers. Cold-rolled transformer steel can be used to manufacture transformers of smaller weight and dimensions.

In the next few years the world's largest complex of shops for the production of cold-rolled transformer steel will be activated at the Novolipetsk Metallurgical Plant. It will manufacture high-quality cold-rolled transformer steel of various thickness in sheets and coils, and in various grades as well.

To ensure the radio engineering industry with transformer steel strip needed for the manufacture of transformers, radio-phonograph combinations, television sets, and receivers, plans exist for organizing the production of that strip at the Novo-Lipetskiy Plant and expanding such production in a number of other plants.

Cold-rolled dynamo steel displays, in comparison with hot-rolled steel of this type, better magnetic properties, higher quality of surface, precise dimensions, and higher plasticity. Plans exist for expanding considerably the production of this steel by initiating it in a number of new cold-rolling shops.

The production of dynamo steel by the coiling method in modern hot- and cold-rolling mills will make it possible to supersede the existing technology of production of hot-rolled steel by fagot rolling.

The use of cold-rolled electrotechnical steel is the cardinal prerequisite for technological progress in the domestic transformer and electrical machine building

industry. The employment of such steel creates the conditions for the production of highly economical transformers and electrical machines distinguished by higher power ratings and smaller dimensions.

The increase in the output of rolled sheets will make it possible to satisfy the demand of a number of branches of industry for sheet steel, to increase the output of coated steels, electrotechnical grades of steel in sheets and coils, sheet metal (including electrolytically tinplated and black varnished sheet metals), and curved sections. Moreover, it will be possible to expand the output of electro-welded tubes, inclusive of the tubes with diameters of 720 and 1,012 mm for gas and petroleum trunk pipelines, and in a number of cases, to replace hot-rolled steel by cold-rolled steel in coils and sheets distinguished by their better surface and more precise tolerances.

Eventually sheet production will also be conducted with the so-called planetary mills in which the rolled strip is broken down by a large amount of rolls held together in a hoop ring and pressing against supporting rolls.

In such mills the compression may reach 90 percent in one operation. One such mill will be installed at an Ural plant. The first universal planetary mill of the new design, which compresses the strip from four sides, i. e., according to height and width of cross section, has been devised in the USSR. In such a mill it is possible not only to roll sheet steel but also to complete within one operation an 80-fold drawing of metal, i. e., to carry out the work done by a continuous billet mill with 12 cages.

It is expedient to combine such a mill with an installation for the continuous teeming of steel. In this case a single universal planetary mill will replace the entire roughing and compressing group of shape mills, and it will be possible to process billets with cross section of 300 x 300 into billets with small cross sections and even wire.

The rolling shop of the immediate future can be visualized as one consisting of installations for the continuous teeming of steel, followed in the rear by a universal planetary mill and one or two continuous rolling mills.

The development of the power, chemical, petroleum, and gas industries requires an increased production of steel tubes. In this connection, while the total output of rolled stock during the seven-year period will increase by 53-63 percent, the tube output alone will more than double. The increase in the volume and variety of the output of tubes will be achieved mostly by producing welded tubes, which will account for over 50 percent of the total

volume of tube output. The production of tubes by the method of arc welding under a flux layer will be particularly expanded and developed. In particular, this method will be used to manufacture high-pressure tubes for gas and petroleum pipelines, with diameters of 426 to 1,220 mm. The processes of the induction welding of tubes and the processes of argon-arc and atomic-hydrogen welding will be further developed; the latter types of welding are particularly convenient to apply in the production of tubes of high-alloy steels. In the field of the production of seamless tubes, the task is to manufacture large-diameter seamless tubes, bimetallic tubes, tubes with various types of metallic and nonmetallic coatings, including enameled and plastics-lined tubes, profiled tubes for various purposes, etc.

The problem of producing extra-thin-walled "bezrisochnyye" tubes, which are used in various branches of modern technology, is becoming particularly acute. Our specialists proved that the most efficient method of obtaining such tubes is their production in roller-type rolling mills. Such mills have been designed and constructed for the first time in the USSR.

A roller mill for the cold rolling of tubes carries out the intermittent rolling of tubes in three to six small-diameter rollers with fixed-profile passes along their perimter. The breaking down of a tube is carried out through the reciprocating movement of the working cage, during which the rollers move simultaneously along the tube and along special slats. During that movement they approach and break down the part of tube lying on the path of their travel. Mills of the above-described design are now already in operation in tube plants. They are used to conduct the cold rolling of tubes with diameters ranging from eight to 114 mm and with wall thickness of up to 18 microns. In these mills it is also expedient to manufacture tubes of large diameters -- up to 400-700 mm.

The fundamental schemes of performance of the above-described roller mill for cold rolling of thin-walled tubes in the USSR has been used as the basis for developing a new design of a small-roller planetary mill which is distinguished from mills of similar type abroad by being adapted to the rolling of tubes on a straightening device instead of the rolling of sheet or strip.

A substantial breaking down in one operation is achieved by the large number of rollers passing from three sides over the metal. Thus, e. g., a stainless steel skelp measuring 35 mm in diameter and 1.5 mm in wall thickness is reduced in cold state in one operation to tubes measuring

30 mm in diameter and 0.3 mm in thickness. The productivity of that mill is five to eight times as great as the productivity of the existing tube rolling mills. The high productivity and continuity of the process justifies the assumption that a mill of the above-described design will find broad use in both the cold and the hot rolling of tubes.

The growth of the output of rolled stock should be ensured through the large-scale introduction of the over-all mechanization and automation of all production processes in rolling shops, introduction of the newest high-productivity equipment and pace-setting technology, and widespread replacement and modernization of obsolete equipment.

The most decisive trend of technological progress in national economy, inclusive of metallurgy, should be the over-all mechanization and automation of production processes, which will serve as the basis for another upsurge in labor productivity, reduction of production costs, and improvement in the quality of output. While hitherto the automation of rolling operations has been limited mostly to individual assemblies and processes, now it is necessary to change over to over-all automation, to the establishment of completely automated shops, technological processes, and enterprises.

A substantial intensification of the rolling process is achieved through a broader automation of rolling mills, inclusive of the introduction of the over-all automation of the guidance of machines and mechanisms. Work will be carried out to automate the guidance of drives, clamping devices, rollgangs, manipulators, lifting tables, pull-over skids, etc.

Computing-resolving machines will be applied for the automatic guidance of clamping devices and of attachments for feeding strips and billets in precise lengths. The achievements of computer engineering unlock broad prospects for the automation of production processes. The use of modern computers for the guidance of production processes makes it possible to select and conduct the optimal-mode technological process automatically.

The Seven-Year Plan envisages the installation of high-productivity rolling and tube mills and finishing assemblies ensuring the continuity of the technological process of production and quality control of output, as well as the mechanization and automation of production operations. The application of the principle of the continuity of technological operations to rolling, heat treatment, finishing, marking, etc., is characteristic of the modern rolling shops. The principal rolling mills in the modern

rolling shops are continuous mills which display a high productivity and serve to automate totally the production process and to conduct rolling at high speeds.

The productivity of a modern continuous wire rolling mill with a rolling rate of 25-30 meters/second amounts to over 500,000 tons of wire a year, i. e., every such mill replaces several line-type wire rolling mills. The speed of the hot rolling of sheet steel on continuous mills has risen to 12-16 meters/second, and of the cold rolling of sheet steel -- to 35 and more meters/second. The productivity of the continuous mills for the hot rolling of sheet steel 1.6 to 8-10 mm thick and 2,000 and more mm wide at present amounts to approximately three million tons a year. Continuous mills will find application in the rolling of not only straight but also shaped sections.

The construction of continuous rolling mills is accompanied by the activation of a large amount of continuous lines for pickling, annealing, tinplating, zincplating, shearing, etc., with belts moving at a high speed.

In addition to the activation of new production capacities in the seven-year period, considerable attention is turned to a fuller utilization of the existing capacities of this type. The conduct of large-scale modernization and, moreover, the partial expansion and technological refurbishing of the existing enterprises make it possible in many cases to solve the task of increasing output at much smaller expenditures and within shorter time than would be required by the construction of new enterprises.

The most effective measures for increasing the productivity of rolling mills are replacement of rolling-mill drives for the purpose of intensifying the breaking down of metal and increasing the rolling speed, installation of additional rolling cages, introduction of automation of a number of production processes, installation of rollgangs, pull-over skids, manipulators, and loopings to mechanize the labor-consuming processes and accelerate the rolling pace.

The increase in rolling-mill productivity is promoted by increasing the weight of ingots, slabs and billets, intoducing more progressive grooving of rolls providing for efficient schemes of rolling and increasing the roughing of metal, and redistributing the tolerances for the roughing of metal for the purpose of a fuller utilization of the power of the rolling-mill engine.

The increase in the resistance of mill rolls through their automatic hard surfacing, the use of rolls of high-strength iron, rolls with hardened grooves and harder surface, reduction of the number of changes and overhauls of

rolls through a more efficient specialization and operational scheduling of rolling mills, and the modernization of heating devices and expansion of their capacity -- all this will make it possible to raise still further the productivity of rolling mills.

In the field of the heating of metal prior to its rolling, plans exist for working on the perfection of the designs of heating furnaces, increasing the intensity of heating by, among other processes, using induction heating and converting a number of furnaces to operation on natural gas. Furnaces with an adjustable and regulable atmosphere and with vacuum heating will be used in a number of types of production.

The work on increasing the productivity of rolling mills, conducted in the last few years in our plants, has yielded notable results. For instance, the productivity of one-cage blooming mills at present has reached 2.5-3.5 million tons annually, a total which greatly surpasses the productivity of analogous mills in the United States. The productivity of the modern rail-structural mills reaches 1-1.2 million tons and more of finished rolling stock annually, which is several times as much as the productivity of the old mills of this type.

It is a most important national-economic task to struggle to conserve metal, which can be successful by employing diverse, economical, lightweight rolled sections with minus tolerances and high precision, and rolled stock of low-alloy steel hardened by thermal treatment.

The mastering of the production of thin-walled rolled sections requires an increased precision of rolling, which, in turn, is related to a further perfection of the design of rolling mills, particularly their finishing and prefinishing cages. The most immediate task is to achieve the automatic adjustment of rolling mills, in respect to which the regulation of rolls should take place automatically and ensure the yield of a precisely dimensioned rolled section.

As shown by the experience of the Kuznetsk Combine, the introduction of minimal-tolerance rolling has resulted in increasing by six to seven percent the output of rolled stock from the same number of ingots.

The manufacture of economical lightweight sections and the increase in the deliveries of minimal-tolerance rolled stock as well make it possible not only to reduce the weight of machines and diverse metal structures but also to trim the costs of rolled products.

To economize on metal in the next few years the metallurgical enterprises should convert fully to the manufacture

of beams, girders, and angle sections of the lightweight type, covering all the product varieties envisaged in the specialization of rolling mills. As of 1960 beams and girders will be produced in the lightweight type only. The replacement of the old types of beams and girders by new, lighter ones will make it possible to save 10-15 percent of the metal. In this connection, the project-design organizations have been commissioned to re-examine the designs of the equipment of railroad cars, agricultural, construction, road, and other machinery, oil-well casing pipes and drill cores, and buildings and structures as well, from the standpoint of lightening their weight and saving metal through the use of economical rolled sections and tube and rolled stock of low-alloy steels in their construction.

A large number of the components of building structures and machines cannot be manufactured by hot rolling because of the intricacy of their shape or because of their thinness. In such cases, curved rolled sections will be used. Curved sections assure the optimal cross-sectional distribution of metal, and therefore such sections are much lighter in weight than the hot-rolled sections of equal strength. The use of curved rolled sections in the manufacture of structural and machine components ensures a considerable saving of metal, reduction in the weight of machines and structures, and their faster assembling. During the seven-year period special shops for the manufacture of curved sections are scheduled to be activated in a number of plants.

To reduce the metal losses and labor input involved in the stamping of forgings in plants of the automobile industry, agricultural machine building and railroad car building, plans exist for expanding the variety and volume of the output of periodic rolled sections (with varying cross section). The relevancy of this motion is confirmed by the following example. The use of a periodic rolled section in the manufacture of an automobile crankshaft has made it possible to reduce the metal consumption by 15 percent and to halve the labor input.

In plants of ferrous metallurgy the production of periodic rolled sections of round shape with a diameter varying with the length of the rod will be expanded.

Plans exist for a considerable expansion of the production of periodic rolled sections for reinforcing reinforced-concrete structure, which ensure a tight connection between iron and concrete, complete utilization of the strength of metal, and reduction of the cross-sectional dimensions of the reinforcement. The growth of industrial and residential construction and the use of precast rein-

forced concrete structures are tied to an increase in the output of rolled stock, including rolled wire for prestressed reinforced concrete.

The development of rolling production in the seven-year period will be accompanied by an expansion in the variety of rolled stock, rise in the output of rolled stock of quality carbon steel and alloy steel, and rise in the quality of the released rolled products.

The thermal treatment of rolled metal will be widely practiced. The introduction, in metallurgical enterprises, of the thermal hardening treatment of hot-rolled sheet sections and tubes of carbon and low-alloy steels will assist in increasing considerably the strength and other properties of steels, and it will make possible the replacement of certain grades of low-alloy steel by carbon steel. Thanks to the higher strength, the weight of machinery, equipment and metal structures will diminish which, in turn, will yield considerable savings of metal.

For the purpose of the thermal treatment of plate steel alone, in the course of the seven-year period about 70 thermal furnaces of various designs -- conveyer, cupola, chamber -- with mechanized charging and discharging, are scheduled to be installed in the plants of ferrous metallurgy.

The improvement in the quality of rolled stock should also be achieved through improvements in the quality of metal in ingots. Rolling shops will employ up-to-date methods of cleaning and finishing the semifinished product. Of primary importance to improving the quality of output is a strict observance of the technological regime during all stages of the treatment of metal in rolling mills.

In the next few years the continuous-flow pyro-cleaning of metal is scheduled to be widely introduced. The pyro-cleaning machines will be installed in the rear of the blooming and slabbing mills. This measure will make it possible to reduce greatly, and in a number of cases to eliminate completely, the subsequent adjustments of surface defects and to trim considerably the number of workers engaged in the departments for cleaning and trimming finished products, which at present employ 30-50 percent of the entire personnel of rolling shops.

In addition to the above, work on the automation and mechanization of adjustment operations is expected to be considerably expanded.

Of great importance to increasing the precision of rolling is the improvement of the design of the working cages of rolling mills, improvement of the material and design of bearings, use of multiple-roll mills (when rolling sheet steel and strip), and introduction of automatic inspect-

ion of rolled-stock dimensions and automatic adjustment of the rolling mill.

A reduction of the rolling-mill stoppages caused by the need for replacing worn rolls can be achieved by improving the quality of rolls. Our roll-manufacturing plants have mastered the production of cast-iron rolls with cast passes, displaying a resistance several times as high as that of rolls with incised passes. A substantial increase in the resistance of rolls has also been achieved by using magnesium-treated cast-iron rolls. These rolls are particularly suitable for the sheet mills operating under difficult high-temperature and high-compression conditions. The resistance of the rolls of high-strength cast iron used in sheet mills is two to four times as high as that of the conventional carbon-steel rolls.

To increase the resistance of rolls, magnesium rolls are scheduled to be installed in the immediate future in a number of rolling mills.

A great deal of work will be done to increase substantially the resistance and hardness of the rolls used in cold-rolling mills, by, among other methods, using industrial- and high-frequency currents in their thermal treatment.

An extremely effective measure for increasing the resistance of rolls is their facing with electro-deposited hard alloys and alloy steels. As shown by the experience of the Plant imeni Lenin, rolls with deposited grooves operate 10 times longer than the conventional steel rolls. At the Chrlyabinsk Plant the electro-deposition of the /surfaces of/ rolls of tube mills has increased roll resistance from 3,000-4,000 tons to 20,000-22,000 tons, with mill productivity increasing by eight to nine percent, and yearly savings amounting to 2.5 million rubles. The electro-disposition of rolls also yields a considerable effect for other rolling mills. The increase in the resistance of rolling-mill rolls constitutes a major potential for raising rolling-mill productivity and improving the quality of rolled stock.

The workers of the metallurgical industry of our country face a responsible and glorious task -- the pre-term fulfillment of the targets of the Seven-Year Plan with regard to the level of metal output. The June Plenum of the CC CPSU (1959) pointed to the necessity of adopting without delay measures for ensuring a more rapid development of the new technology and its introduction into industry, including metallurgy.

The workers of metallurgy shall apply every effort to realize the ambitious Seven-Year Plan of Development of

the National Economy of our Homeland.

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